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Biochemical assessment of the nutritional status of the Eskimos of Wainwright, Alaska[1,2]

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The Eskimo village of Wainwright is located on the Arctic coast of Alaska, 90 miles southwest of Point Barrow, the northernmost point of the United States. Of the limited number of nutrition studies conducted in Alaska (1–9), no attention has been given to the nutritional status of this remote Eskimo village.

The present report is concerned with the findings of a nutritional evaluation of the population of Wainwright conducted during January 1969. The study was conducted in cooperation with the United States International Biological Program on the health and biology of circumpolar human populations.

Methods and material

Subjects

At the time of the study, 308 Eskimos were carried on the village census roll. Fasting urine or blood samples, or both, were obtained from 129 of these persons. Major emphasis was placed on the 2- to 12-year age group; children in grades 9 through 12 were not available for study as they were away at boarding schools, primarily in Anchorage. Samples were obtained from members of the Wainwright National Guard Reserve Unit; the majority of the able-bodied Eskimo men of the village were members of the unit.

Methods

The blood samples were measured for hemoglobin (10) and hematocrit; serum total proteins (10), albumin, globulins, electrophoresis patterns (11), and abnormal hemoglobins (11, 12).

The urine samples were acidified immediately upon collection with hydrochloric acid then placed in amber bottles, a few drops of toluene were added, and then the samples were frozen. The samples were analyzed for creatinine (13), total nitrogen (14), calcium (15), phosphorus (16), thiamin (17), riboflavin (18), and available vitamin B_6 (19). Thiamin and riboflavin were analyzed by microbiological assay employing *Lactobacillus viridescens* and *Lactobacillus casei*, respectively, and vitamin B_6 was analyzed by *Saccharomyces carlsbergensis* assay. The urinary measurements are expressed in terms of units per gram of creatinine.

Electrical and logistical limitations due to the remote location of the village and the weather conditions prevailing in midwinter restricted sample procurement and the performance of certain desired biochemical analyses. Hemoglobin and hematocrit determinations were performed locally, but samples were air-shipped frozen to Denver where the remaining analyses were conducted.

During the survey, detailed anthropometric measurements were made, reproductive histories collected, and information was obtained on the food resources of the village, food practices, the school lunch and Head Start programs, health services, and other related activities.

Results and discussion

The population of Wainwright is distributed among 52 households. The median age of the population in 1968 was 18.6 years for males and 13.6 years for females, a young population as indicated by the population profile (Fig. 1). In contrast, the United States white population had a median age of 29.5 years (1960 United States census of population). Details concerning the demography of Wainwright were presented in a separate report (20).

The growth of the Eskimo children through age 15 is plotted on State Uni-

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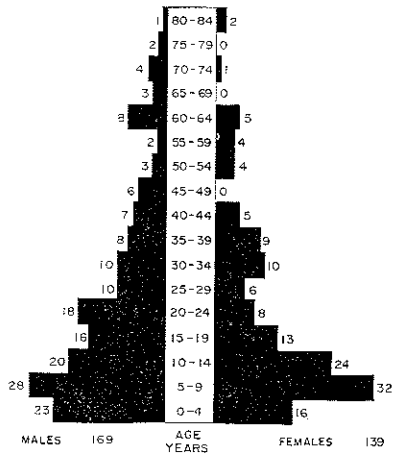

FIG. 1. Population profile for Wainwright, Alaska based on July, 1968 census roll.

versity of Iowa growth charts (Figs. 2 to 5). During the years of 5 through 15, the height and weight of the children followed the Iowa norm fairly closely, although cases of underweight and overweight were encountered. Younger boys and girls were below the Iowa norm in terms of height resulting frequently in a stocky or stout appearance. When the height and weight measurements are compared with the Alaska Health Research Center curves (7), the present data are in general agreement. The slower rate of length increment in the Wainwright Eskimo children substantiates the observations made on other groups of Eskimo children (2, 3, 6, 8).

Evaluation of the biochemical data obtained indicated that the most significant nutritional problem of the Wainwright Eskimo was the anemia noted in the children under 6 years of age (Table 1). Using the guidelines indicated in Table 2, we found one-half the children ages 2 to 6 had hemoglobin levels considered "at risk." Of the 14 children under 2 years of age studied, 5 appeared anemic. In the older age groups, only an occasional subject was observed to have evidence of anemia. One member of the National Guard unit was found to have a hemoglobin level of 13.8 g/100 ml blood, which is considered slightly less than acceptable. All other members studied had hemoglobin levels well above 14.0 g. Anemia has been reported previously to occur in other Alaskan Eskimo groups (1, 5, 21). The anemia has been considered to be due largely, although not entirely, to inadequate intakes of iron (1, 5). In the present study, the anemia in the children appeared to be largely of the microcytic and hypochromic type, suggesting inadequate intakes of iron. This in part may be related to the nutritional and social practices of the Wainwright Eskimo, which contribute to a nutritional neglect of the preschool child. In recognition of the anemia problem, iron supplements were to be provided for the preschool children through the Head Start program. Based on National Nutrition Survey guidelines (22), all of the subjects studied had acceptable serum protein (mean, 6.93 g/100 ml) and serum albumin (mean, 4.42 g/100 ml) levels with resulting acceptable albumin–globulin ratios. These findings were supported by the normal serum electrophoresis patterns obtained. In addition, no abnormal hemoglobins were detected in any of the 40 subjects screened. The normal serum protein levels observed were similar to those of other reports (2, 3, 8) and are probably a reflection of the high protein intakes. The high intakes of protein, largely from caribou and fish sources, resulted in high urinary nitrogen excretions (Fig. 6). The lowest excretion noted was by a 13-year-old girl (4.97 g/g creatinine).

Based on the urinary excretion data, intakes of thiamin and riboflavin appeared to be adequate for all of the Eskimos studied. For most subjects, the intakes of these vitamins were apparently quite high as reflected by exceptionally high urinary excretions. Subjects under 15 years of age excreted a mean of 1.30 mg thiamin/g creatinine and 1.69 mg of riboflavin/g creatinine. Subjects 15 years of age and over excreted a mean of 0.38 mg thiamin/g creatinine and 1.10 mg riboflavin/g creatinine. Using the National Nutrition Survey guidelines (22), none of the subjects, regardless of age, excreted less than the acceptable levels of either thiamin or riboflavin.

Information on vitamin B_6 nutriture in population groups is limited. The adequacy of vitamin B_6 in the diet of the Wainwright Eskimo was evaluated on the basis of urinary excretion of this nutrient (Table 3).

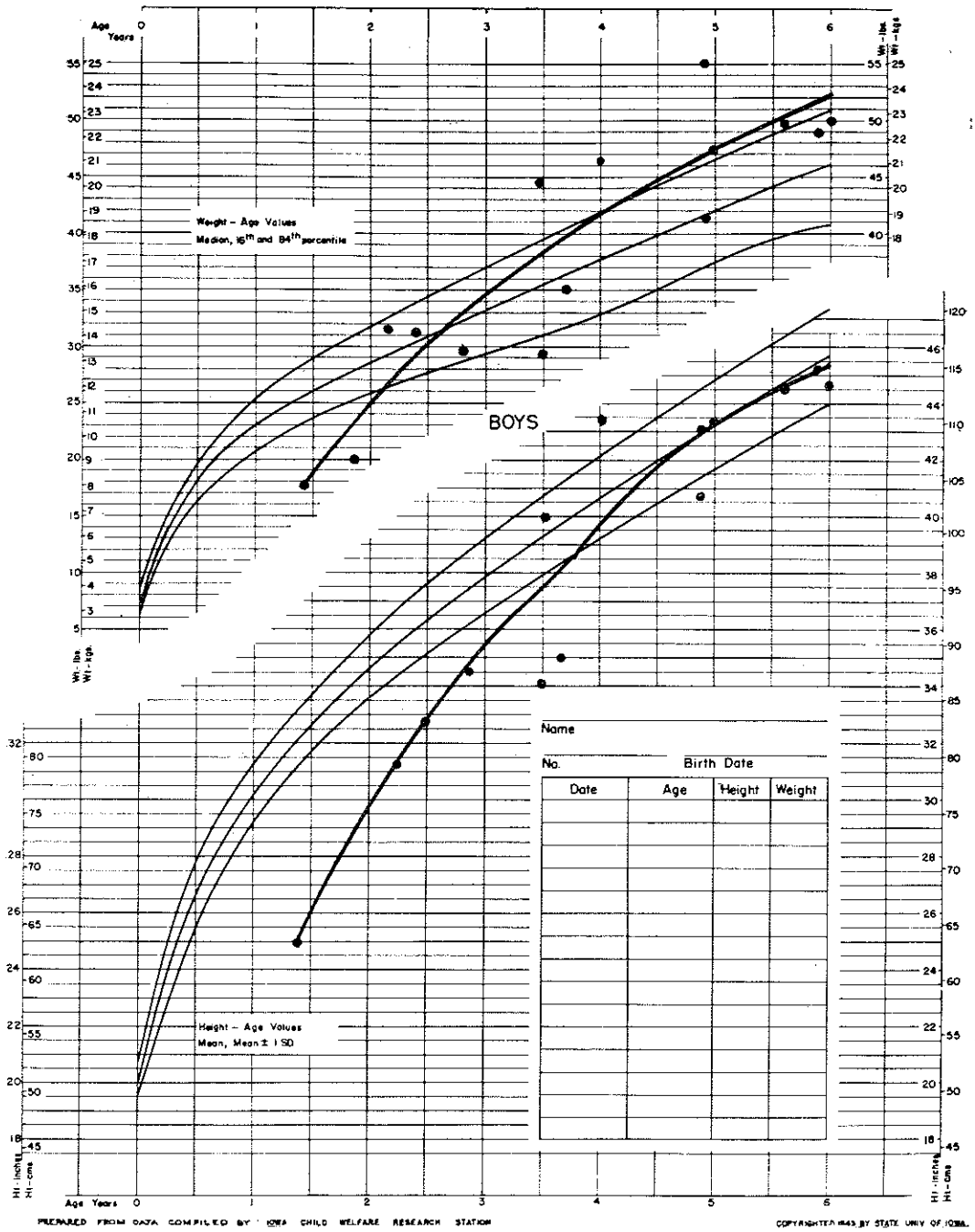

FIG. 2. Weight and height of Wainwright Eskimo boys 1 to 6 years of age.

Using the guidelines indicated, the majority of the subjects appeared to have adequate intakes of vitamin B_6. However, individuals with marginal or unacceptable excretion levels of the vitamin were encountered. This was particularly evident among the children younger than 10 years in whom 34% of those studied had unacceptable excretion

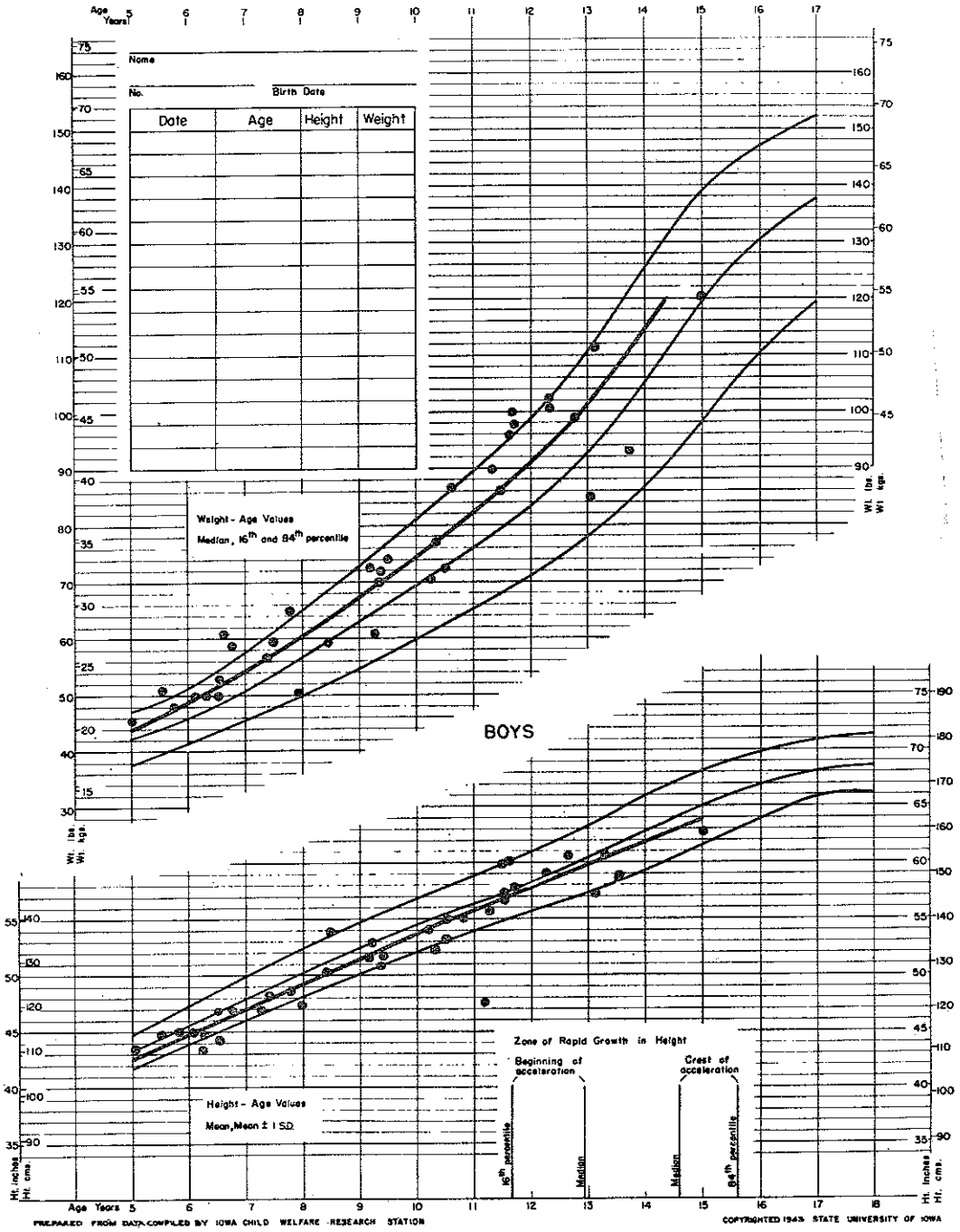

FIG. 3. Weight and height of Wainwright Eskimo boys 5 to 15 years of age.

levels of the vitamin (Table 3). It should be mentioned that tuberculosis problems still exist at Wainwright village. Isoniazid is commonly employed for treatment, with each member of the village receiving isoniazid for 1 year in every 10 years as a preventative measure. In discussions with members of Barrow Hospital, Barrow, Alaska, it was re-

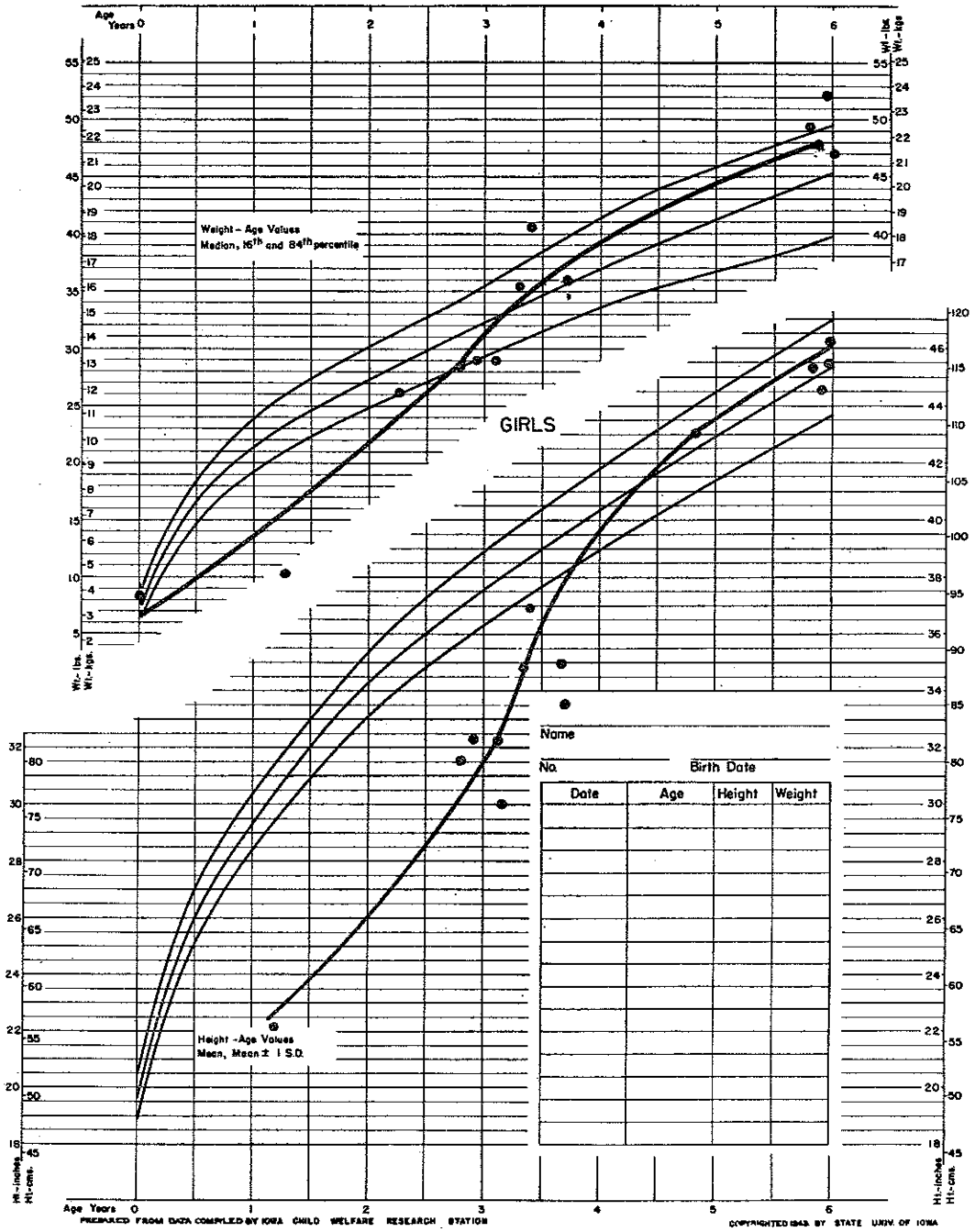

FIG. 4. Weight and height of Wainwright Eskimo girls 1 to 6 years of age.

vealed that mental disturbances and problems were noted with the use of isoniazid. Recently, vitamin B_6 supplements were provided to be used in conjunction with the isoniazid therapy as a means of eliminating or minimizing the mental disturbances.

The dietary intakes of calcium and phosphorus were apparently quite adequate based

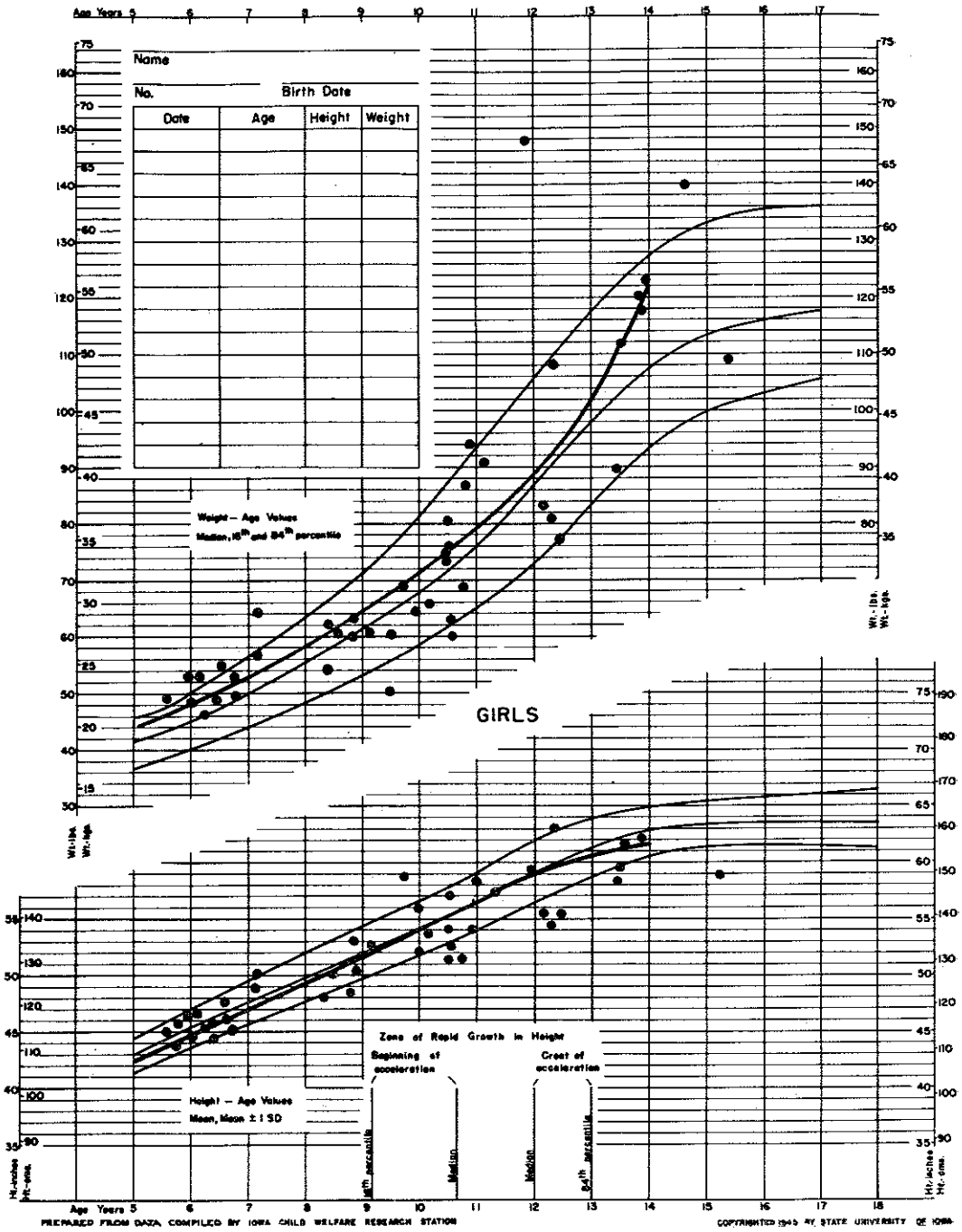

FIG. 5. Weight and height of Wainwright Eskimo girls 5 to 15 years of age.

on the relatively high urinary excretion levels of these nutrients (Figs. 7 and 8). However, three children under 9 years of age and four between the ages of 11 and 13 excreted less than 35 mg calcium/g creatinine. The urinary excretions of calcium and phosphorus by the adults were comparable to those encountered in nutrition surveys of United States Army

TABLE 1

Blood data on the Eskimo population of Wainwright, Alaska

Subjects	No. of subjects	Average hematocrit, %	Average hemoglobin, g/100 ml	Subjects with hemoglobin levels considered "at risk"	
				n	%
Children, <2 years	14		10.1	5	36
Children, 2–5+ years	23	38.7	11.1	12	52
Children, 6–12+ years	55	38.2	13.6	2	4
Women, ≧13 years	14	38.4	13.2	2	14
Men, ≧13 years	23	44.3	15.4	2	9
All subjects	129	39.6	13.1	23	18

TABLE 2

Guideline for classification of hemoglobin and hematocrit data

Measurement	At risk	Acceptable
Hemoglobin, g/100 ml		
<2 years	<10.0	≧10.0
2–5+ years	<11.0	≧11.0
6–12 years	<11.5	≧11.5
13–16 years, male	<13.0	≧13.0
13–16 years, female	<11.5	≧11.5
>16 years, male	<14.0	≧14.0
>16 years, female	<12.0	≧12.0
Hematocrit %		
<2 years	<31	≧31
2–5+ years	<34	≧34
6–12 years	<36	≧36
13–16 years, male	<40	≧40
13–16 years, female	<36	≧36
>16 years, male	<44	≧44
>16 years, female	<38	≧38

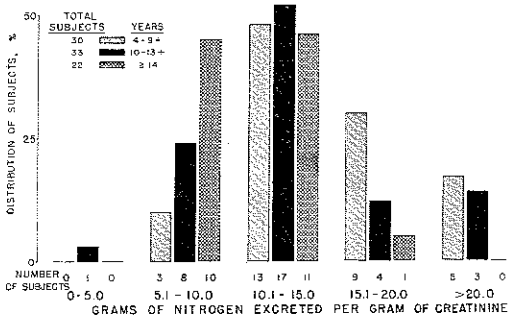

FIG. 6. Urinary excretion of nitrogen by Wainwright Eskimos by age groups.

personnel (J. E. Canham, personal communication).

Logistical and survey conditions did not permit the opportunity to obtain information on serum vitamin A and ascorbic acid levels. Based on the extent of supplements used, it would appear that the vitamin A intakes of the schoolchildren would be adequate. Each student was given one or two tablets daily, each containing 4,000 USP units of vitamin

TABLE 3

Urinary excretion of vitamin B_6 by various age groups

Age group, years	No. of subjects studied	Urinary excretion of vitamin B_6, μg/g creatinine		Acceptable level of excretion of vitamin B_6, μg/g creatinine	Subjects with unacceptable vitamin B_6 excretion
		Average	Range		
4–6+	8	122	58–198	≧80	2
7–9+	22	97	42–227	≧60	6
10–12+	24	97	46–170	≧40	1
13–15+	9	109	53–194	≧30	0
≧16	24	41	11–91	≧20	1

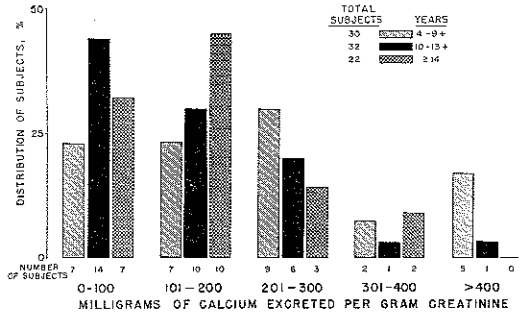

FIG. 7. Urinary excretion of calcium by Wainwright Eskimos by age groups.

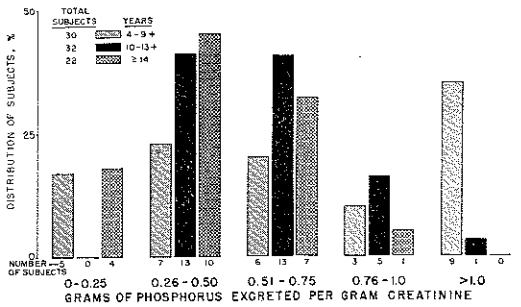

FIG. 8. Urinary excretion of phosphorus by Wainwright Eskimos by age groups.

A (cod-liver oil concentrate) and 400 USP units of vitamin D (as D_3). Some of the vitamin capsules distributed also contained ascorbic acid, thiamin, and riboflavin. The schoolchildren were provided a school lunch each day, and although many of the items used in the school lunches are not commonly found in the Eskimo diet, the lunches were readily accepted. For many of the schoolchildren, the school lunch represented the most important meal of the day. In addition, the school was recently built and provided excellent facilities for preparing and serving the school lunches.

The cooperative store as the sole village outlet for provisions represented a significant source of calories and other nutrients in the Wainwright Eskimo diet. A listing was made from the store procurement records of the items and quantities imported into the village during the previous year; the items are brought in by boat in a single delivery, usually during September. The main items sold by the store were flour, sugar, preserves, fats, evaporated milk, and starchy items (e.g., breakfast cereals, rice, rolled oats, crackers, corn meal, and cookies). A number of items that would provide ascorbic acid were also brought in including canned vegetables, juices, simulated citrus beverages, and fruits. Some of the imports per year were: evaporated milk, 24,000 cans (14½ oz); sugar, 11,240 lb; flour, 31,500 lb; rolled oats, 3,240 lb; corn meal, 2,200 lb; crackers (soda, graham, pilot bread), 8,700 lb; rice, 2,300 lb; and fats (butter, lard, margarine), 5,200 lb. In addition, 14,400 cans (12 oz) of sweet soda pop were purchased; alcoholic beverages were taboo. Virtually all of the imported items were sold before the arrival of the next ship a year later.

Most of the protein consumed was obtained locally by hunting and fishing (caribou, fish, seal, whale, ugrug, et cetera); excess meats were frozen in permafrost cellars for later use. Aside from the cooperative store, a few families make small purchases of provisions that are delivered by airmail. Much of the money used for purchases is derived from government payments (Welfare, Social Security, National Guard, et cetera), fur trapping, and limited salaried employment (e.g., DEW Station).

Information was obtained from a number of households as to the food consumed and food sources. In general, the Wainwright Eskimo eats "most anything," although the food available was rather limited in variety; he normally prefers meat raw or lightly cooked as the main dietary component. Some food is purchased from the cooperative store, particularly sugar, evaporated milk, crackers, and flour to make breads, rolls, and sour dough. Tea or coffee, with heavy additions of evaporated milk and sugar, was the common beverage consumed. Coal was available from the shores of the Arctic Ocean for cooking purposes; fuel oil was also shipped in for heating and cooking requirements. The light cooking practices of the Wainwright Eskimo undoubtedly tend to preserve the vitamin content of the meats.

Summary

A nutritional assessment was conducted of the Arctic Eskimo village of Wainwright, Alaska. Nutritional information was obtained on 129 members of the village population of 308. Blood samples were measured for hemoglobin, hematocrit, serum total proteins, albumin, electrophoresis patterns, and abnormal hemoglobins. Urine samples were analyzed for thiamin, riboflavin, vitamin B_6, total nitrogen, calcium, and phosphorus. From the findings it would appear that the Wainwright Eskimos, aside from the anemia and marginal intakes of vitamin B_6 encountered in the younger children, are in a generally acceptable nutritional state despite their harsh environment and limited resources.

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